University rankings as knowledge organization systems: an analysis of their classification nature

Rankings universitarios como sistemas de organización del conocimiento: un análisis de su naturaleza clasificatoria

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Resumen

Teniendo en cuenta que los sistemas de organización del conocimiento (SOCs) constituyen el centro del campo disciplinar de la organización del conocimiento, este artículo busca identificar y caracterizar los rankings universitarios a partir del análisis de su naturaleza clasificatoria. Para esto, se analizan los tres más importantes rankings universitarios internacionales (THE, Shanghai y QS) en términos de sus notaciones, facetas, ediciones y periodicidad de actualización. Los resultados confirman que estos rankings actúan como sistemas de clasificación facetados cuya estructura refleja sesgos contextuales específicos. Por otro lado, su dinámico proceso de actualización permite una constante remodelación de su estructura, así como de la preponderancia de cada faceta.

Palabras clave: Sistemas de organización del conocimiento. Rankings universitarios. Estructuras clasificatorias.

Abstract

Considering the knowledge organization system as a core issue in the knowledge organization field, this paper focuses on international university rankings as a new incarnation of KOS through an analysis of their classificatory nature. For this, three important international university rankings are analyzed: THE, Shanghai, and QS in terms of their notation, facets, citation order, editions, and updating. The results confirm their classificatory nature as essentially faceted systems whose structure is derived from specific contextual slants and whose dynamic updating process leads to a constant remodeling of the structure and the weight of the facets.

Keywords: Knowledge Organization Systems. Higher education rankings. Classificatory structures.

1. Introduction

According to Ingetraut Dahlberg (2006), knowledge organization (KO) as a field of study consists at its core of logical structures for conceptual representation as well as of the concept naming activities by means of the most suitable terms. For Green (2008), such conceptual representation and naming is based on relationships which form the basis of a user's search for information. These structures and representations take the form of specific tools, which we call Knowledge Organization Systems, or KOS (Mazzochi, 2017).

Knowledge Organization Systems (KOS) have been occupying, over time, a core position in knowledge organization studies, especially in the Information Science field, as they act as instruments for processing a socially produced knowledge – what Buckland once called "information as thing" (Buckland, 1991) – in order to make possible knowledge appropriation by society and the further generation of new knowledge, in a typically helical movement (Hodge, 2000; Guimarães, 2017). As mediating spaces between a socially-produced knowledge and the production of new knowledge, knowledge organization processes are concerned with the construction of surrogates of knowledge (Olson, 2002) in order to make possible different kinds of social appropriation.

Thus, it is through the KOS that the development of analytic-synthetic processes of KO result in representations of various orders. In their function as bridges between the user information needs and the actually available information, Knowledge organization systems offer the user a structure, defined by enumerated elements and the relationships among them, which represents a knowledge domain: a domain consisting of various schemas that reflect the domain's semantic structure, and a suite of tools for navigating through a network of labels, definitions, typologies, relationships and properties of concepts (Hodge, 2000; Zeng, 2008; Soergel, 2009; Bratková & Kucerová, 2014).

A KOS, as Barité (2001) points out, lends itself to both scientific and documentary purposes, re-

vealing itself in different configurations (classification schemes, subject heading lists, thesauri, taxonomies, conceptual maps, ontologies, etc.). Particularly noteworthy are the classification systems, as they exhibit structural elements of a logical-linguistic nature that, historically, have contributed significantly to information organization and retrieval. It is relevant to point out that the increasing complexity of social reality has led to the need for more complex knowledge organization systems which are able to take on broader functions, by assuming hybrid approaches, new designs and, as a consequence, receiving new denominations (Vickery, 2008; Lauruhn & Groth, 2016).

In order to facilitate the processes of both knowledge organization and information retrieval, the KOS displays complex structures and relationships (Mazzochi, 2017), complexities that represent the underlying semantic structures and complexities of a certain knowledge domain and furnish a navigation framework by means of a set of labels, definitions, typologies, relationships and properties of the concepts (Hodge, 2000; Zeng, 2008; Soergel, 2009; Bratková & Kucerová, 2014).

Those "semantic tools" (Brascher, 2014: Mazzochi, 2017) can appear under the form of classification, categories, and relationship lists (Hodge, 2000) and can be evaluated according to their "semantic richness." Nowadays the KOS have moved beyond traditional information environments such as libraries, and are facing new challenges and roles, especially in a time when ssociety is permeated by semantic web, Google search engines and big data algorithms (Mazzochi, 2017).

More especially in the present century, new configurations of KOS have arisen, not necessarily focused on representing subjects in documents but nonetheless furnishing weighted representations of information contents in order to support broad processes of evaluation and decision-marking. One such example of this movement beyond libraries is the case of international university rankings whose KOS nature was already noticed by Tennis (2012) when he pointed out that the simple presence of hierarchies in KOS is an evidence of a ranking process.

Nowadays, with the high level of competitiveness among universities in search of international recognition and broader sources of financial resources, the university rankings perform evaluations of universities around the world and are gaining ground, based on different criteria, whose published results serve as an element for self-assessment and strategic action planning of these universities, as well as by providing input to government agencies and research funding agencies (Dehon, Jacobs & Vermandele, 2009; Hongcai, 2009; Millot, 2015; Axel-Berg, 2018). In this sense, three important roles, among others, can be outlined for them: a) support for decision-making for high school graduates; b) means of university self-evaluation; and c) informing alumni "about the status of their almae matres," for funding purposes (Hongcai, 2009).

To fulfil these roles, such rankings employ structural elements that allow us to categorize them as special modalities of classification systems, especially when we consider that hierarchies are implicit rankings (Tennis, 2012). Moreover, such rankings have a weighted nature, an aspect previously studied in traditional KOS, by Sparck-Jones (1973); Salton and Buckley (1988); Foskett (1996); Kang; Lee (2005); and Ren; Sohrab (2013), among others.

University rankings are much more than a simple quantitative set of data; they actually organize specific knowledge that was amassed by the universities throughout the year and recorded in very detailed surveys – the documentary basis for those KOS – in order to support the construction of a new knowledge, as it occurs in the three roles mentioned above.

As it occurs in other KOS, they present a structure that is both paradigmatic (lexical) and syntagmatic (relationships that can be established among the lexical unities), that responds to specific documentary situations and informational needs (Gardin, 1966, 1973; Natali, 1978; Peters & Weller, 2008).

The purpose of this paper is to present the university rankings as knowledge organization systems, and, as a consequence, to analyze the structure of ARWU, THE, and QS international university rankings as a kind of weighted classification system.

2. Methodology

The research corpus was a set of results from three important international university rankings - Times Higher Education Ranking (THE), Academic Ranking of World Universities (Shanghai Ranking), and Quaquareli Sysmonds (QS) – along the period of five years (2016 to 2019). These rankings were analyzed according to the following structural classification aspects: coordination and subordination of concepts, faceting, citation order, notation, editing modalities, explanatory notes for use, and updating.

The first international university ranking – Academic Rankings of World Universities or simply

Shanghay Ranking (ARWU, s.d.) - was created in China, in 2003, in order to respond to a specific demand of the Chinese government for funding purposes.

This ranking featured a preponderance of North American Universities, and in 2004 the British newspaper Times Higher Education (THE, s.d.; Baty, 2010) countered with its own global university ranking, in an effort to promote British universities as World Class learning centers, rather than merely successful domestic ones. In the beginning, this ranking was developed by British universities rankings together with the educational management consultancy firm Quacquarelli Symonds (QS, s.d.), arguing that higher education systems needed to be assessed on a broader range of criteria (Baty, 2010). In 2009, Quacquarelli Symonds consultancy left Times Higher Education cooperation and created its own ranking after Thomson ISI data.

2.1. Shanghay Ranking - ARWU

Shanghay ranking, nowadays know as Academic Ranking of World Universities (ARWU), was first published in 2003 by the Center for World-Class Universities of Shanghai Jiao Tong University, China, and published year-by-year. Since 2009, it has been published by Shanghai Ranking Consultancy, which is a fully independent organization on higher education intelligence and not legally subordinated to any universities or government agencies.

There is no easy way to define a world class university, or its principal indicators, so AWRU made an attempt to quantify and measure excellence in order to form strategic goals for Chinese institutions.

To minimize problems, this ranking is based on open and verifiable institutions' information, and so avoids many of the criticisms levelled at the Times Higher and Quaquarelli Symonds rankings about the lack of transparency and clarity in methodology. It does not contain a reputational survey so it is not driven by commercial interests. By this means, it is considered the most rigorous and objective of the global rankings (Axel-Berg, 2015).

In ARWU, more than 1,500 universities are evaluated, but only the top 500 are ranked. Results are presented in groups by region or country. This ranking is based on four main areas: quality of education, quality of faculty, research output and per capita performance. There are two more side rankings in Shanghai, ARWU FIELD and ARWU SUBJECT, where both rankings use same criteria, only with slight modifications in weightings and application.

2.2. Times Higher Education Ranking – THE

The first appearance of the Times Higher Education ranking – THE – took place in 2004 as a data collection for students' assessment of the leading world-class universities across the six continents. However, with the success of its predecessor (AWRU), this ranking sparked the interest of universities in gathering information about how themselves are faring from year-to-year and in comparison with other similar institutions.

THE has classified its rankings in 4 broad categories: world, teaching, subject and regional. All of them derive from World University Ranking, first and most powerful of THE publications.

In the world group, there are two rankings: global and reputation rankings. Teaching rankings have been recently created and analyze specific concepts: Wall Street Journal/Times Higher Education College Rankings, Japan University Rankings, Europe Teaching Rankings. In the category regional ranking, there are four sections: Emerging Economies University Rankings, Latin America University Rankings, Asia University Rankings and Young University Rankings. In the subject category, the global ranking that covers eleven broad areas of knowledge and research.

All these sub-rankings are derived from the World ranking but with special modifications to better reflect its specific characteristics.

In its latest edition, the Times Higher Education World University Rankings 2019 included more than 1,250 universities. One of the most controversial elements of the THE is its reputational survey, which attempts to bridge all the inevitable problems of interpretation through a massive synthesis of more than 20,000 responses.

Adding to the controversy is the fact that significant amounts of important data are supplied by the universities themselves. Attaching so much importance to a university's "reputation" is problematic, especially nowadays when information available on the internet is not always reliable, and an academic staff group that provides the data is often focused on a specific subject area and does not have an overview of other universities.

And while it is important to universities to participate in the ranking, once the basic principles of the metrics calculation are known, it is easy to game the system to produce desirable results.

2.3. Quacquarelli Symonds Ranking - QS

The Quacquarelli Symonds ranking – QS - , as previously mentioned, is run by a consulting firm,

whose concerns are more related to the commercial side of rankings. As such, their metrics are much less focused on bibliometric performance indicators and much more on reputation and institutional perception.

Relying so much on such a questionable indicator proves to be a doubtful initiative, since it clearly favours universities with international marketing and profile. In 2019 edition, QS World ranked 1,000 institutions. As a reputational ranking proposal, the greater the number of rankings, the greater the QS return.

Alongside its worldwide impact and recognition, QS created others rankings: QS World University Rankings by Subject, QS Higher Education System Strength Rankings, QS Best Student Cities, QS World University Rankings by Region BRICS (Brazil, Russia, India, China, South Africa), Asia, Arab region, Latin America, EECA (Emerging Europe and Central Asia), QS University Rankings by Location: Mainland China, India, Japan, South Korea and Mexico, Global MBA Rankings, QS Business Masters Rankings, and QS Top 50 Under 50, where this last one highlights the world's top 50 universities established within the last 50 years, based on the most recent edition of the QS World University Rankings. It is a ranking factory on demand.

As for the indicators, Academic and Employer Reputation are metrics related to QS surveys that collate expert opinions and employers opinion on those institutions from which they source the most competent, innovative, effective graduates.

Faculty to Student Ratio is an indirect metrics for teaching quality, where a high number of faculty per student is equivalent to a more appropriate learning environment. Citations per Faculty is a performance indicator measure by the total number of citations received by all papers produced by an institution in a five-year period divided by the number of faculty members at that institution.

All citations data is sourced using Elsevier's Scopus database. International Faculty and Students is a internationalization measure of an university. Other QS rankings derive from these central indicators and they are calibrated to meet the demand of each ranking.

For the final score calculation, QS normalizes each indicator using z-scores. These normalized scores are scaled down from 100 to 1, with 100 being the score achieved by the best performing institution.

3. Results and discussion

The first result to point out is the faceted structure of the three analyzed rankings, by means of a set of indicators and subindicators which are applied under a weighted scale in order to furnish a final notation (classification score). Their analytic-synthetic nature is evidenced by the fact that all of them presuppose an analysis by means of the application of each indicator and sub-indicator and a synthesis by means of weighting that will result in the final score, which consists of the relative position of the university among the others. Such a score represents the notation of the KOS – in all the cases they are purely numerical – since they act as "system of written symbols that can be combined according to some set of syntactical rules to represent various meanings in a specialized domain and can be considered as special languages, for specific purposes " (Sammet ; Tabory, 1968).

Guimarães; Campbell; Milani; Holland. (2019) furnish a synthesis of the facets and subfacets of the mentioned university rankings with the correspondent weight (that will lead the citation order), as follows:

THE World 2019

- Teaching (30%): Reputation survey (15%); Doctorates-awarded- to-academic-staff ratio (15%); Staff-tostudent ratio (4.5%); Doctorate-to-bachelor's ratio (2.25%) ; and Institutional income (2.25%)

- Research (30%): Reputation survey (18%); Research income (6%); Research productivity (6%) • Citations (30%): [no sub-facets]

- International outlook (7.5%): International-to-domestic-student ratio (2.5%); International-to-domestic-staff ratio (2.5%); International collaboration (2.5%)

- Industry income (2.5%): [no sub-facets]

ARWU (Shanghai) 2019

- Quality of Faculty (40%): Staff of an institution winning Nobel Prizes and Fields Medals (20%); Highly cited researchers in 21 broad subject categories (20%)

- Research Output (40%): Papers published in Nature and Science (20%); Papers indexed in Science Citation Index-expanded and Social Science Citation Index (20%)

- Quality of Education - Alumni of an institution winning Nobel Prizes and Fields Medals (10%): [no subfacet]

- Per Capital Performance - Per capita academic performance of an institution (10%): [no sub-facets]

QS World 2019

- Academic Reputation (40%): [no sub-facets]

- Citations per Faculty (20%): [no sub-facets]

- Faculty to Student Ratio (20%): [no sub-facets]

- Employer Reputation (10%): [no sub-facets]

- International Faculty (5%): [no sub facets]

- International Students (5%); [no sub-facets]

Each facet and sub-facet (indicator and sub-indicator) has specific instructions to its application, by providing definitions, exceptions, exclusions, etc. Those instructions act in the same sense of thesauri scope notes.

The three rankings analyzed have ordinal numerical notation and are published in full editions (global) or partial editions (continent, knowledge area, emerging countries, young universities, disciplines, social impact etc.).

The forms of coordination and subordination of concepts for composition of the classificatory notations vary chronologically (from year to year) as well as from ranking to ranking.

Although the fundamental categories are similar - Teaching, Research, Internationalization, Industrial Income etc. - the facets of each category vary substantially in their configuration, as is the case with Shanghai ranking which, unlike the others, values Nobel Prizes and Fields medals in the research facet, or even the different sources used for analyzing the publications and the scientific impact of the universities, such as Scopus or Web of Science.

The citation order of the facets for the composition of the notation, in turn, is evidenced by the weight that each facet has in the evaluation, with variations between the fundamental facets mentioned above.

The explanatory notes for use (a kind of Scope Notes) refer specifically to the composition of each sub-facet, and tend to be more specific within the scope of the Education and Industrial Revenue facets, as specific instructions on the concept of each indicator modality and its definition especially when the indicator include complex quantitative procedures.

Because some of the analyzed rankings have the so-called reputational nature, with part of the evaluation made by consulting experts, there is a

detailed set of instructions on such form of evaluation, in order to provide a more equitable evaluation.

Finally, and like traditional bibliographic classification systems, university rankings have a periodical review system, which can focus on the weight change of an indicator/sub-indicator (influencing the construction of a facet/sub-facet) or even on the inclusion, alteration or suppression of a particular sub-facet.

Once the university rankings share the same characteristics of traditional KOS analicitc-synthetic procedures, faceted structures, application rules, notations, different kind of editions and a formal annual revision procedure, we should consider that they are also permeated by conceptions, paradigms, and tendencies (slants) or even prejudices (biases) that purely contextual (from their provenance) and are inserted in time and in space (Barité, 2001; Guimarães, 2017).

One example for this is the emphasis of Shanghai ranking in the so-called hard sciences, once the facet Research is deeply influenced by the sub-facet "Nobel Prizes and Fields Medals" and also by Papers published in Nature and Science. Another example comes from THE which gives a specific emphasis in funding resources (industry income), in a more typical Anglo-American system, with the payment of tuitions, and not considering the cases of German and Latin-American public universities totally sponsored by the government.

The three analyzed rankings present a structure with a pre-established set of categories and sub-categories as well as weights for all of them. The mentioned structure comprises economic, reputational (based on surveys among academics all over the world) and bibliometric data.

The information sources are also quite different especially in terms of publications and citations, because QS and ARWU have their analysis based on Web of Science while THE is based on Scopus. Those two data bases have different coverages and focuses.

The category "reputation" in THE, ARWU and QS is strongly subjective and vary substantially from ranking to ranking.

In order to summarize the comparison among the analyzed rankings, we notice that:

- Notation: all the three rankings are KOS with pure notation (ordinal numbers);

- Up-to-dating: all the rankings are up-to-dated every year;

- Facets: ARWU has 4 main facets (Quality of Faculty, Research Outuput, Quality of Education, and Per capita Performance); THE has 5 main facets (Teaching, Research, Citation, International Output, and Industry Income); and QS has 6 main facets (Academic Reputation, Citations per Faculty, Faculty to Student Ratio, Employment Reputation, International Faculty, and International Students);

- Editions: ARWU has 4 types of editions (Global, 5 Broad Fields; Subject ; and Special Focus Institution); THE has 7 types of editions (World, Young Universities, Subject, Teaching, Emerging Economies, Asia, and Latin America); and QS has 5 types of editions (World, Top 50 under 50, Subject, by Region, and Graduate Employability).

4. Conclusion

The analyzed rankings provide structures to organize knowledge about university research, teaching, funding and internationalization as a support for the development of new knowledge for various purposes (research, management, selfevaluation, marketing, etc). They present a typical classificatory structure with notations, citation order, updating, editions and specific scope notes.

As with any other KOS, these rankings present biases in accordance with their historicity, purpose and provenance and those aspects are especially relevant at the moment one decides to adopt the results from one or from another ranking. In this sense, such practices as the emphasis in hard sciences in ARWU, the emphasis on reputation (based on surveys sent to academics all over the word) in QS and the Industry Income in THE represent clear biases that need to be carefully observed.

Another aspect that deserves attention is the subject list of each ranking because they are quite different. On the other side, the quick process of updating (annually), the different kind of editions and the constant revision of criteria (indicators and subindicators) reveal a dynamism of those KOS, in accordance to the fast speed of our times.

Acknowledgement

References

ARWU (2019). Academic Ranking of World Universities. http://www.shanghairanking.com/ARWU-Methodology2019.html.

Axel-Berg, Justin (2015). Competing on the world stage: the Universidade de São Paulo and Global Universities Rankings. São Paulo: USP (MSc Thesis).

Axel-Berg, Justin (2018). Indicadores para efeito de comparação internacional no ensino superior brasileiro brasileiro (Indicators for international comparisons in Brazilian higher education). // Marcovitch, Jacques (ed.) Repensar a universidade: desempenho acadêmico e comparações internacionais. São Paulo: ComArte; Fapesp. 31-44.

Barité, Mario (2001). Organización del conocimiento: un nuevo marco teórico-conceptual en Bibliotecología y Documentación. // Carrara, Kester (ed.) Educação, universidade e pesquisa (Education, university and research), Marília: UNESP, 35-60.

Baty, Phil (2010). THE World University Rankings. London: The Times Higher Education Supplement.

Brascher, Marisa (2014). Semantic relations in knowledge organization systems. // Knowledge Organization. 41:2, 175-180.

Bratková, Eva; Kucerová, Helena (2014). Knowledge organization systems and their typology. // Revue of Librarianship. 25:2, 1– 25.

Buckland, Michael (1991). Information as thing. // Journal of the American Society for Information Science. 42:5, 351-360.

Dahlberg, Ingetraut (2006). Knowledge organization: a new science? // Knowledge Organization. 33:1, 11-19.

Dehon, Catherine; Jacobs, Dirk; Vermandele, Catherine (2009). Rankings and research assessment in higher education: current and future challenges. // Dehon, Catherine; Jacobs, Dirk; Vermandele, Catherine. Ranking universities. Bruxelles: Ed. de l`Ùniversité Libre de Bruxelles, 1-11.

Foskett, Anthony Charles (1996). The subject approach to information. 5.ed. London: Facet.

Gardin, Jean-Claude (1966). Elements d' un modèle pour la description des lexiques documentaires. // Bulletin des Biblioteques de France. 5, 171-182.

Gardin, Jean-Claude (1973). Document analysis and linguistic theory. // Journal of Documentation. 29:2, 137-168.

Green, Rebecca (2008). Relationships in knowledge organization. // Knowledge Organization. 35:2/3, 50-159.

Guimaraes, José Augusto Chaves (2017). Slanted knowledge organization as a new ethical perspective. Andersen, Jack; Skouvig, Laura (eds.). The organization of knowledge: caught between global structures and local meaning. Bingley: Emerald. 87-102.

Guimarães, José Augusto Chaves; Campbell, Donald Grant; Milani, Suellen Oliveira; Holland, Helber (2019). Cultural biases in knowledge organization systems: a discussion regarding international university rankings. Philadelphia: NASKO, 7, 48- 62.

Hodge, Gail (2000). Systems of knowledge organization for digital libraries: beyond traditional authority files. Washington, DC: Council on Library and Information Resources. http://www.clir.org/pubs/reports/pub91/contents.html (2019.02.28)

Hongcai, Wu (2009). University rankings: status quo, dilemmas, and prospects. // Chinese education and society. 42:1, 42- 55.

Kang, S.; Lee, S. (2005). Document indexing: a concept-based approach to term weight estimation. // Information Processing and Management. 41:5,1065-1080.

Lauruhn, Michael; Groth, Paul (2016). Sources of change for modern knowledge organization systems. // Knowledge Organization. 43:8.

Mazzochi, Fulvio (2017). Knowledge organization systems. // Encyclopedia of Knowledge Organization, ISKO. https://www.isko.org/cyclo/kos#ref (2019.02.25)

Millot, Benoit (2015). International rankings: universities vs. higher education systems. // International Journal of Educational Development. 40, 156–165.

Natali, Johanna W. (1978). Documentação e linguística: inter-relação e campos de pesquisa. // Revista Brasileira de Biblioteconomia e Documentação. 11:1/2, 33-42.

Olson, Hope A. (2002). The power to name: locating the limits of subject representation in libraries. Dordrecht: Kluwer Academic.

Peters, Isabella; Weller, Katrin (2008). Paradigmatic and syntagmatic relations in knowledge organization systems. // Information-Wissenschaft und Praxis, 59:2, 100-107.

QS TOP UNIVERSITIES. (2019). (2019.20.03) https://www.topuniversities.com/university-rankings

Ren, F.; Sohrab, Mohammad. G. (2013). Class-indexing-based term weighting for automatic text classification. Information Sciences, 236, 109-125.

Salton, Gerald; Buckley, Chris A. (1988). Term-weighting approaches in automatic text retrieval. // Information Processing and Management. 24, 513-523

Sammet, Jean E.; Tabory, Robert (1968). Artificial languages. In: Kent, Allen; Lancour, Harold (eds.) Encyclopedia of Library and Information Science. New York: Dekker, 632-657.

Soergel, Dagobert (2009). Knowledge organization systems: overview. www.dsoergel.com/SoergelKOSOverview.pdf (2019.03.31)

Sparck- Jones, Karen (1973). Index term weighting. // Information Storage and Retrieval. 9, 619-633.

Tennis, Joseph. T. (2012). A convenient verisimilitude or oppressive internalization? // Knowledge Organization. 39:5, 394-397.

THE World University Rankings (2019). https://www.timeshighereducation.com/world-university-rankings (2019.03.31)

Vickery, Brian C. (2008). On 'knowledge organisation'. http://www.lucis.me.uk/knowlorg.htm#start (2019.04.18)

Zeng, Marcia L. (2008). Knowledge Organization Systems (KOS). // Knowledge Organization. 35:2/3, 160–182.